Cultivating skills for 21st century professionals: Development & assessment of process skills in ecology and conservation biology


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Students complete a Pre-Content Assessment of their knowledge of the subject.

Students complete a Self-Assessment about their level of confidence in the skill.

Students complete a Post-Content Assessment about their knowledge of the subject.

Two levels of teaching intervention, an intensive class study and a light, individual student study, will take place between EX1 and EX2 in the first and second semester, respectively.

Next Steps
Revised, final materials for the three target skills will be piloted by at least 17 professors from a diversity of institutions during the next four semesters. For more information about this project: ncep@amnh.org.

Goals
A concern exists that US undergraduate science students do not currently develop important process skills needed as professionals. Our project aims to:

- Develop instructional materials that promote key student skills important for conservation biology and other integrative fields.
- Pilot these materials in the classroom to collect data on the development of those skills and determine what works best in terms of instruction.

Study Questions
- Do students improve their abilities in relation to the targeted process skill?
- Do students’ confidence in their abilities change in relation to the targeted process skill?
- Do students accurately diagnose their own level of development in relation to the targeted process skill?
- Are changes in process skill performance correlated with content-related performance?
- Is the intensity of the teaching intervention correlated with the overall gains in process skills?

3 Skills Targeted
- Critical thinking: the habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion.
- Data analysis: the systematic process of exploring issues, questions or problems through the collection and analysis of evidence that results in informed conclusions or judgments.
- Oral communication: a prepared, purposeful presentation designed to increase knowledge, to foster understanding or to promote change in the listeners’ attitudes, values, beliefs, or behaviors.

Student Gains
In Spring 2011, we (Sterling) piloted preliminary instructional materials developed for oral communication skills in a Conservation Biology class at Princeton University (N = 21).

Content: The class showed medium gains in content understanding between pre and post content assessments (Normalized gains pre-post: g = 0.51 ± 0.28; Figure 1A).

Confidence: Student confidence on their oral communication skills also increased in a Conservation Biology class at Princeton University (N = 21).

Skill: Oral communication skills increased significantly from the first exercise to the second (Normalized gains pre-post: g = 0.31 ± 0.83; Figure 1C). Overall, there were significant gains in delivery, content and supporting material, visual aids and text, and timing (Wilcoxon signed-rank test: P ≤ 0.05).

Preliminary Results

Justification

Experimental Design

Seminars 1 and 2

A professor applies two exercises during the semester. Both exercises target the same skill, such as “oral communication.”

Key Questions

Within Semesters
Gains in content?
Gains in skill?
Changes in confidence?
Do they correlate with each other?

Across Semesters
Is the intensity of the teaching intervention correlated with the overall gains in process skills?

A Closer Look at the Assessment Tools
Assessment tools are used in conjunction with the exercises:

Exercise 1

Key Question
Exercise 2

Pre-Content Assessment
Self-Assessment Assessment Rubric
Post-Content Assessment

Figure 1A. Frequency distribution of normalized content gains among students (N = 19); A. Pre and post content assessment. Box plots show the median, upper and lower quartiles, highest and lowest data values (N = 21); B. Frequency distribution of normalized skill gains among students in oral communication (N = 21).